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ON A THEOREM OF KINEMATICS.

BY PAUL SAUREL.

IT is a well known theorem of kinematics that every displacement of a rigid body is equivalent to a rotation followed by a translation parallel to the axis of rotation. The following elementary demonstration of this theorem may be of interest.

We shall assume the following theorems:

I. Every displacement of a plane figure in its plane is equivalent to a translation, or to a rotation about some point of the plane.

II. Every displacement of a rigid body about a fixed point is equivalent to a rotation about an axis passing through that point.

As a corollary to the first of these theorems it follows that every displacement of a rigid body which transforms a system of parallel lines into itself, is equivalent to a rotation about one of the parallel lines followed by a translation in the direction of the lines, or to two translations, one perpendicular, the other parallel to the lines in question.

From the second of the above theorems it may be shown in the usual way that every displacement of a rigid body is equivalent to a translation followed by a rotation. Consider three points of the body, not lying in a right line, which are initially in the positions A_1, B_1, C_1 and finally in the positions A_2, B_2, C_2. A translation of the body will move the first point from the position A_1 to the position A_2, while the second and third points will take the positions B_1', C_1'. From theorem II it follows that these points may then be brought from the positions B_1', C_1' to the positions B_2, C_2, by a rotation about an axis through A_2.

After the translation every line of the body occupies a position parallel to its original position; after the rotation only those lines of the body which were parallel to the axis of rotation occupy positions parallel to their original positions. Thus, if the displacement considered is not equivalent to a translation, there is one and only one system of parallel lines which is transformed into itself, namely, the lines parallel to the axis of rotation.

From the corollary to the first theorem the desired theorem now follows at once: *Every displacement that is not equivalent to a translation is equivalent to a rotation followed by a translation parallel to the axis of rotation.*

Incidentally it may be noticed that, however we decompose the displacement into a translation and a rotation, the axis of rotation is always one of the system of parallel lines which the displacement transforms into itself.

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